COLONIAL IMPORTS.

How to expend among our own people more than $200,000,000 a year, which the people of the United States have been in the past sending abroad, is discussed in the Annual Report of the Chief of the Bureau of Statistics, which has just been made public. The suggestion grows out of the nearer relations between the United States and Cuba, Porto Rico, Hawaii, and the Philippines which have developed during the year. The report shows that the people of the United States have been sending abroad more than $250,000,000 a year in the purchase of the class of articles produced in these islands which may, with the introduction of American capital and energy, enormously increase their production and supply practically all of those articles of tropical growth for which we have in the past been compelled to send money abroad. While it is hoped and expected that the farmers of the United States will steadily and rapidly increase their sugar-producing abilities through the growth of the beet and the establishment of beet sugar factories, there still remains, aside from sugar, nearly $200,000,000 worth of tropical productions annually imported, and up to the present time the total of tropical productions imported, including sugar, has been over $250,000,000 annually.

Discussing this question, the report says: "The interest felt in the prospective effect upon our commerce of the events of the past year has been apparent in the inquiries which have reached this bureau from every part of the country. The production and consumption of the islands coming into closer relationship with us, and their ability to supply our own wants and to open a market for our surplus products, have been the subject of eager inquiry.

"This question naturally divides itself into three distinct propositions: First, how much they can supply of the class of articles for which we have in the past been compelled to send money abroad; second, how large a market they can themselves offer for our products; third, the introduction to other markets which their control may offer to our own producers and manufacturers.

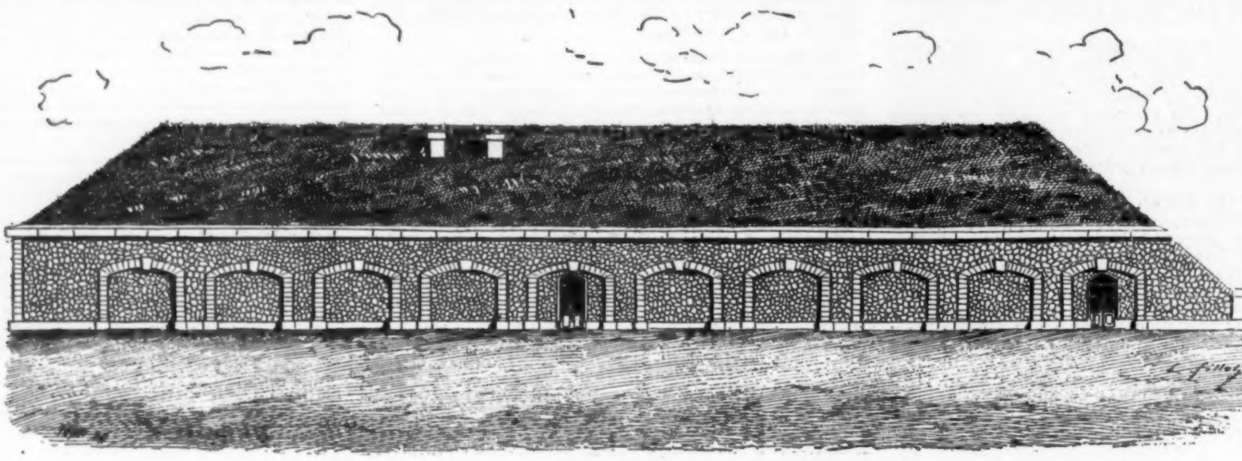
"Our annual importations of the classes of articles produced in the islands of Cuba, Porto Rico, Hawaii, and the Philippines have for years averaged fully $250,000,000 annually. Of coffee our annual importations amount to nearly $100,000,000 per year; of sugar nearly another hundred millions, and of tropical fruits, tobacco, hemp, and other articles of this character, fully fifty millions more. All of these are produced readily in these islands, and in most cases their production can be greatly increased. With the introduction of American capital, energy, and ingenuity, it seems not unreasonable to assume that they may supply practically all of the $250,000,000 worth of these productions which we have been compelled to buy abroad, and instead of spending that money annually among the people of other nations, we shall be enabled to distribute it among those having interests identical with our own and representing American capital and American enterprise. It is worthy of note that a large share of the coffee which we annually import now pays an export tax of twelve per cent. before leaving the country of production, thus giving a marked advantage to those entering upon its production in localities where export duties are not collected.

"The following table shows the value of coffee, sugar, and other tropical productions imported into the United States in 1896, that year being selected as more nearly normal than those of later date, in which changes in tariff rates affected the year's record:

"VALUE OF PRINCIPAL ARTICLES OF TROPICAL PRODUCTION IMPORTED INTO THE UNITED STATES DURING THE YEAR ENDING JUNE 30, 1896.

Articles.	
Coffee	$84,793,124
Sugar	89,219,773
Fruits and nuts	16,957,307
Tobacco	18,703,942
Hemp, jute, etc.	11,846,247
Miscellaneous articles (estimated)	30,000,000
Total	$251,320,393

"The direct market offered by the islands brought into closer relationship with us by the events of the year amounts to fully $100,000,000. The annual importations into Porto Rico under normal conditions amount to about $16,000,000; those into Cuba about $65,000,000; those into the Philippines about $22,000,000, and Hawaii $7,000,000, making a total of about $110,000,000, which seems likely to be greatly augmented with increased production and business activity. A very large share of the articles imported for these markets is of the classes produced in the United States, and the disposition to purchase these largely from the United States was apparent even under former adverse conditions, and especially so during the period in which reciprocity agreements so rapidly increased our exportations to them. Much greater than these, however, is the market offered by the countries commercially adjacent to the Philippines, whose importations amount to $1,200,000,000 annually, and whose chief points of distribution lie, many of them, as near to Manila as does Havana to the city of New York."



THE MAGAZINE BEFORE THE EXPLOSION.

THE EXPLOSION OF A POWDER MAGAZINE AT TOULON, FRANCE.

AT 2:15 A.M. on the morning of March 6 the powder magazine of Lagoubran, situated at the north of Seyne Bay, a mile and three-quarters from Toulon, blew up. The sole witnesses of the explosion were the sentries on guard about the encircling wall, and they were all killed. The other victims of the catastrophe, both military and civil, were killed in their beds while asleep, while those who survived heard only a sudden crumbling sound followed by an indescribable roar. It is possible, therefore, to get an idea of this terrific explosion of nearly two hundred tons of powder only by examining its disastrous effects.

On March 5 the powder magazine, or rather the twin magazines, of Lagoubran stood parallel to each other between the village and the bay. The two buildings were identical in construction, both being built of enormous blocks of masonry solidly cemented together and covered with a solid bed of earth devoid of trees or grass.

The guardhouse stood between them on a rocky hillock, and they were separated from the mainland by a moat bordered by trees, which was half filled with mud at the time. Beyond the ditch was an inclosing wall, a railway running from the arsenal at Toulon to the powder works and to Seyne, an upward-sloping stretch of ground planted with gardens, the road from Toulon to Seyne bordered with dwellings which formed the village of Lagoubran, and finally the hills, which the quarries there in operation had given the appearance of cliffs. On the east were some ditches and a large basin, and on the west the powder-mixing buildings, cartridge shops, storage buildings for melinite, etc.

TREES BESIDE THE RAILROAD, HALF A MILE AWAY FROM THE MAGAZINE.

On March 6 the appearance of these places was changed as by a deluge. In place of powder magazine No. 1 there was to be seen only a hole filled with water. North of this there was no longer any vestige of wall, railway, or road, but merely a chaos, out of which emerged only trunks of branchless, mutilated trees and pieces of wall, indicating the site of the solidly built houses of Lagoubran. The outline of the hills at the back

THE VILLAGE OF LAGOUBRAN AFTER THE EXPLOSION.

was the only thing that remained the same. There was devastation right and left; enormous stones lay in the fields; the roofs of the houses had fallen in; and it was plainly to be seen that the force of the explosion had all been toward the north.

It was like the discharge of a colossal cannon. The hillock which backed the magazine on the north formed a sort of breech. As the combustion took place in the central passage of the magazine, the first impulse of the gas was toward the north wall, which contained many doors and consequently offered less resistance. Behind on the south side it seemed to make but two outbursts; one demolished the guardhouse, killed the soldiers who were there, and destroyed the adjoining dwelling of the chief guardsman, who, as if by a miracle, got out safe and sound with his wife and child; the other damaged severely the northeast corner of the other magazine, demolished a dredger in a nearby basin, and knocked to pieces some small buildings used for charging projectiles with melinite. On the east and west the walls fell out, breaking into pieces, which were blown one hundred yards away. The roof and the earth which covered it simply rose in the air and fell again in the same place. All this would not have been so serious had it not been for the irresistible projection of the pieces northward, which, unfortunately, brought them upon the village. The wall, raised from the bottom of its foundations, formed a ball. The ground on which it stood was torn up with it. The mud of the half-filled moat increased the mass, and the whole, like an avalanche plunging over the mountain side, fell on the houses of Lagoubran. The cliffs of the hills alone could check the advance of this death-dealing mass.

It was dark at the time of the catastrophe, and the hours that followed were dreadful. Cries of agony, the escape of half-crazed wounded, the calls of the first rescuers, and exclamations of horror at each discovery of a new corpse, added to the inevitable confusion in organizing aid by the uncertain light of torches.

Then came the arrival of the populace of Toulon and Seyne, who had been awakened with a start by the explosion and were guided by the enormous black cloud which hung over the place of the disaster. In the center of Toulon the concussion was so great as to break all the windows that were not provided with shutters.

The photographs which we reproduce give a very good idea of the appearance of the place after the explosion. It took the soldiers and officers of the garrisons of Toulon and Seyne three days to recover the remains of their comrades; and many of the bodies were found buried under a yard and a half of earth, mud, and debris of every kind.

According to the official report, fifty-four men were killed and one hundred wounded, thirty-three very seriously. The dead were placed in rude coffins and given a solemn funeral, which was largely attended by the mourning populace of the city.

All that can be done now is to make material compensation to the survivors and to investigate the causes of the explosion. The investigation will doubtless be carried on with difficulty, as all the witnesses are dead and nothing remains but a hole in the ground. It has been noised abroad that the accident was purely a chance one, probably caused by the spontaneous combustion of a small quantity of powder. It seems strange, however, if the modern explosives are apt to detonate so easily without apparent cause, that the second magazine did not blow up also, for one of the doors was demolished in a room where opened cases of powder and projectiles were stored.

On the other hand, so soon as the day after the explosion, two criminal attempts on buildings in which explosives were stored were reported to have been discovered, and details as precise as improbable were published, and confirmed by the official report of the commandant of the post.

Have the real facts been greatly exaggerated by the madness of a civil and military population, to whom the explosion has revealed what permanent dangers menace them? Or must we believe, on the contrary, in a series of criminal attempts, one of which has been consummated? We cannot discard summarily either hypothesis. But whatever may have been the cause of the disaster at Lagoubran, it is certain that the situation of the Toulonnais, living as they do among thousands of tons of powder, is far from enviable.

Whether the powder in the magazines is capable of catching fire spontaneously at any moment, or whether it is possible for a criminal hand to set a fuse in a case of dynamite, Toulon courts the same risk, namely, that of awaking any day, like Pompeii, under the ashes of the artificial volcanoes which surround it. And the worst of it all is that there does not seem to be any practical and immediate remedy for this disturbing state of things.

We are indebted to Le Monde Illustré for the illustrations and to L'Illustration for the description of the explosion.

SOLDIERS DIGGING FOR VICTIMS.

HUGE STONE BLOCK THROWN ONE HUNDRED YARDS BY THE EXPLOSION.

VARNISHES, ETC., USED IN BUILDING STRUCTURES, BY WOOD WORKERS, ETC.

THE various kinds of woods used in the building of a house, decoration of a room, erection of a staircase, etc., necessitate the employment of special kinds of varnish; what is suited for a soft hearted wood will not do for a hard wood, and vice versa. The preliminary treatment each wood should receive before being varnished has to be adapted to each particular case, and it will be the purpose of this paper to set forth the precise treatment required in each case, according to the nature of the wood to be varnished. There is another point of consideration also, which is of great importance to all who use varnishes, and that is concerning the actual composition of the varnish in use. Since the American introduction of turpentine and linseed oil substitutes, many inferior varnishes are sold that play all sorts of pranks after being laid on wood. Resin oil, for instance, is very often used as an ingredient in cheap varnishes, but this oil will never dry, and forms a sticky mass that the slightest heat will soften and cause to run. To counteract this action, when such substances form the components of a varnish, a quickly evaporating fluid, such as naphtha or benzine, is used; by this addition, however, the varnish thus prepared is only rendered worse, as will be seen presently. Common resin and colophony (the refuse or residuum obtained from the distillation of turpentine) is also largely used as a substitute for resins. This body acts very much like resin oil in its non-drying nature, with the additional disadvantage that the coat of varnish when dry is brittle and pulverulent, and can be rubbed off easily. When a varnish consists of two such antagonistic bodies as resin oil and naphtha or terebene, or some other quickly evaporating hydrocarbon, the coat of varnish will dry in streaks, leaving great fissures between, showing the wood beneath. This is due to the fact that the quickly volatile fluid forsakes the solid ingredients of the varnish before the latter have had time to dry uniformly and hard, and, as a consequence, the solid parts of the varnish contract on themselves and eventually dry up into semihard streaks. It is a fraud to call such an article a "varnish."

Varnishes are chiefly of two kinds, oil varnishes and spirit varnishes; the latter kind are easily prepared by any one, as they do not require special or elaborate apparatus for their production. In oil varnishes, however, a special plant is required for boiling the oil, dissolving the "gum" (it is a common but incorrect practice to call the resins used in varnish making "gums"), and mixing the ingredients. These latter kind of varnishes are more expensive than spirit varnishes, and are likewise more special in their application.

Spirit Varnishes.

As a rule the plant required by the novice for making spirit varnishes will be the following: Some two gallon stoneware bottles, earthenware pans with covers, a closed-in stove in which can be placed the vessel in which the solids are dissolved, a few large size tin funnels over which should be stretched fine linen or other suitable filtering material arranged so as to dip slightly into the funnel, a zinc or iron trough six inches high, which can be filled with sand and placed on the stove; this apparatus is for maintaining a constant temperature, a uniform heat, by which means the spirit or other explosive fluid in which the solids are being dissolved will not be raised to an explosive heat.

The harder resins, such as copal, amber, etc., are not easily dissolved in spirits and hydrocarbon liquids. Therefore, the resins usually employed in making spirit varnish are the softer kind, such as sandarac, kauri (Australian copal of a soft kind), anime, dammar, mastic, and shellac; the latter material is used in very large quantities.

Oil Varnishes.

The plant required in making these varnishes consists of a specially constructed boiling vessel or "gum pot" (which is set in a brick constructed furnace, but capable of being raised by a pulley and crane, so as to be quickly removed in the event of its contents boiling over), and receiving vessels, as already mentioned. It will not pay to make oil varnishes on a small scale for one's own use, as the expense of plant would be too great, and, moreover, the skill required is such as can be obtained only by long and extensive experience. To enable the reader, however, to form some idea of what the actual composition of the oil varnishes on the market is (or rather what it should be if genuine), recipes and formulæ for preparing them are included in this paper.

Making Spirit Varnishes.

In the following formulæ it will be best to work on some definite plan, such as the following: Select a two gallon stone jar that can be corked tightly; into this put the solid ingredients in a finely powdered state; on them pour the solvent fluid, and then set it in the sand bath buried three or four inches deep, but be sure quite two inches of sand remain underneath the jar; then gently heat the sand, and before the contents of the jar become hot, put in the cork and continue the heating until the solids are dissolved; an occasional shake-up of the contents will hasten and facilitate the process. It is well not to put the cork in at once, as methylated spirit absorbs moisture, and therefore any moisture in the bottles would be absorbed and the varnish thus produced be dull; by leaving out the cork until the contents become warm the moisture will be expelled, and then by corking up the bottles the spirit will not be lost by evaporation unless the contents become very hot. It is quite safe to raise the temperature until the spirit boils, but such a heat is seldom required. If the solids are such as readily cohere or become one solid mass, such as sandarac resin, it is well to put in coarsely pounded glass with the powdered resins, but before use all such varnish will require to be filtered through some fabric. When straining a spirit varnish, it is well to tie the fabric over the top of an earthenware pan and then put a cover on while the varnish is straining, so as not to lose any of the spirit by evaporation, which would not only be a loss of material, but also render the varnish too thick or viscid. If the varnish is not wanted at once, it is clarified by allowing it to stand undisturbed for a

week or two, and then carefully pouring off the clear fluid from the dregs.

Varnish for Walnut.

Ingredients:

Methylated spirit	160	fl. oz.
Nigrosine (for spirit)	⅛	oz.
Bismarck brown red	1	"
Shellac (orange or ruby)	24	"

Preparation.—Dissolve the nigrosine and Bismarck brown in the spirit, and then dissolve therein by warm digestion the shellac. There are two kinds of nigrosine, one soluble in spirit, the other soluble in water; be sure and use the right kind. By varying the proportions of these two dyes, the color or shade can be altered at will.

Varnish for Ebony.

Ingredients:

Methylated spirit	160	fl. oz.
Nigrosine (for spirit)	2	oz.
Shellac	24	"

Varnish for Mahogany.

No. 1:

Methylated spirit	160	fl. oz.
Dragon's blood	1	oz.
Shellac	24	"

Digest the dragon's blood for several days in the spirit before dissolving therein the shellac. But the color of mahogany is better imitated by using Bismarck brown red, with just a little nigrosine to tone down the redness.

No. 2:

Methylated spirit	160	fl. oz.
Sandarac resin	16	oz.
Shellac	8	"
Venice turpentine	9	"
Dragon's blood	4	"

Varnish for Oak (Common).

This is not a spirit but a turpentine varnish, which will not bear rubbing, but is a quick drying varnish and lustrous.

Ingredients:

Turpentine	160	fl. oz.
Common resin	56	oz.

This varnish does not require straining.

Walnut Staining Varnish.

This and the following varnishes are for rapidly coloring and varnishing soft or hard white woods simultaneously, so as to imitate the real wood.

Ingredients:

Methylated spirit	160	fl. oz.
Walnut spirit stain	3	oz.
Amber resin, powdered	24	"
Shellac	24	"

Digest in the sand bath.

Oak Staining Varnish.

Ingredients:

Methylated spirit	160	fl. oz.
Spirit stain	5	oz.
Sandarac resin, powdered	8	"
Shellac	20	"
Amber resin, powdered	24	"
Methylated ether	4	"

Mix the ether and spirit together and then dissolve therein the solid ingredients by the aid of the sand bath.

Mahogany Staining Varnish.

Ingredients:

Methylated spirit	160	fl. oz.
Mahogany spirit stain	4	oz.
Shellac	24	"
Sandarac resin, powdered	8	"
Amber resin	24	"

Proceed as above.

Ebony Staining Varnish.

Ingredients:

Methylated spirit	160	fl. oz.
Shellac	24	oz.
Gum benzoin	3	"
Lampblack	5	"

Digest as above, and stir up well to mix the black pigment with the gums when dissolved.

Another formula. Ingredients:

Methylated spirit	160	fl. oz.
Ebony spirit stain	8	oz.
Shellac	24	"
Sandarac resin, powdered	10	"
Amber resin	24	"

Proceed as above.

All the above staining varnishes require straining before use. The spirit stains are made by dissolving suitable aniline colors in strong spirits of wine.

A Red Staining Varnish

is prepared from the following ingredients:

Coal tar naphtha	160	fl. oz.
Common resin	40	oz.
Red oxide of iron sufficient to give the required color.		

A Colorless Varnish for Wood.

Ingredients:

Methylated spirit	100 to 120	fl. oz.
Shellac	80	oz.
Mastic resin	7	"

Dissolve by standing in a cool place for several days, giving it a frequent shake-up.

Varnish to Show the Grain of the Wood.

Ingredients:

Methylated spirit	160	fl. oz.
Orange shellac	19	oz.
Sandarac	12¼	"
Colophony	12¼	"
Camphor	3	"

Dissolve all the solids but the colophony in the spirit, add the latter, and then put the vessel in the sand bath and heat the contents until boiling. Then filter or strain off through felt filtering bags, and give the filtered fluid twelve hours' rest to clarify before use.

A common varnish for general use is prepared by dissolving

Shellac	16	oz.
Methylated spirit	160	fl. oz.

But a much better product is obtained as follows: Dissolve

Resin	48	oz.
Spirits of turpentine	50	fl. oz.

And then let it stand for a few days, occasionally shaking it up, then mix with it 800 fluid ounces of boiled oil and, after shaking, to well mix the two, let it rest in a warm place until clear, when the clear portion should be decanted, and for use thinned with turpentine as desired.

A dark varnish for light woods is prepared by digesting together at a gentle warmth:

Annatto	1	part.
Methylated spirit	256	"

And then add

Shellac	1	lb.
Sandarac resin	2	"
Mastic resin	⅓	"
Elemi	½	"
Venice turpentine	1	"
Dragon's blood	¼	"

This may be thinned with more spirit if desired.

Dammar Varnish.

Ingredients:

Turpentine	160	fl. oz.
Gum dammar	80	oz.
Sandarac resin	40	"
Mastic resin	8	"

Kauri Copal Varnish.

Ingredients:

Methylated spirit	160	fl. oz.
Kauri copal	48	oz.
Mastic resin	24	"
Chloroform	54	fl. oz.

The two fluids are mixed and the solids dissolved therein.

Varnish for Wood in General.

No. 1. Ingredients:

Naphtha	160	fl. oz.
Shellac	16	oz.
Sandarac resin	6	"
Benzoin	½	"
Copal varnish	6	"

Dissolve the resins in the naphtha and then add the copal varnish.

No. 2. Ingredients:

Methylated spirit	160	fl. oz.
Sandarac resin	26½	oz.
Shellac	6½	"
Resin	13½	"
Venice turpentine	20	"

Digest at a gentle heat.

Transparent Varnish Suitable for White Woods.

No. 1. Ingredients:

Methylated spirit	160	fl. oz.
Sandarac resin	½	lb.
Dammar	½	"
Gum thus	1	"
Manila copal	1	"
Elemi	1	"

No. 2. Ingredients:

Methylated spirit	160	fl. oz.
Soft kauri copal	30	oz.
Camphor	4	"
Mastic	8	"
Venice turpentine	4	"

This is a quick drying white varnish that may be polished when hard.

No. 3. Ingredients:

Methylated spirit	160	fl. oz.
Manila copal	1	lb.
Sandarac resin	1	"
Gum benzoin	1	"
Gum thus	2	"

No. 4. Ingredients:

Methylated spirit	160	fl. oz.
Sandarac resin	32	oz.
Mastic resin	8	"
Canada balsam	16	"

No. 5. Ingredients:

Methylated spirit	160	fl. oz.
Manila copal	32	oz.
Mastic resin	8	"
Camphor	4	"
Venice turpentine	4	"

Dissolve the camphor and copal in the spirit before adding the other ingredients.

No. 6. Ingredients:

Methylated spirit	160	fl. oz.
Sandarac resin	40	oz.
Mastic resin	8	"
Anime resin	2	"

No. 7. Ingredients:

Methylated spirit	160	fl. oz.
Sandarac resin	32	oz.
Mastic resin	8	"
Canada balsam	16	"

Hard Spirit Varnishes.

No. 1, Brown:

Methylated spirit	160	fl. oz.
Shellac	8	oz.
Sandarac resin	16	"
Elemi resin	4	"
Venice turpentine	4	"

No. 2, Brown (for common purposes):

Methylated spirit	160	fl. oz.
Shellac	12	oz.
Resin	12	"

No. 3, Brown:

Methylated spirit	160	fl. oz.
Sandarac	24	oz.
Shellac	16	"

No. 4, Brown:

Methylated spirit	160	fl. oz.
Sandarac resin	24	oz.
Shellac	16	"
Turpentine varnish	20	fl. oz.

Made by dissolving brown resin in turpentine in the proportion of 1 part resin, by weight, to 20 parts turpentine, also by weight.

No. 5, White:

Methylated spirit	160	fl. oz.
Sandarac resin	40	oz.
Gum thus	16	"

No. 6, White:

Methylated spirit (65 over proof)	160	fl. oz.
Sandarac resin	40	oz.
Camphor	½	"
Coarsely powdered glass	16	"

After straining, add 20 fl. oz. of pale turpentine varnish.

No. 7, White:

Methylated spirit	160	fl. oz.
Sandarac resin	24	oz.
Mastic resin	8	"
Elemi resin	4	"

No. 8, White:

Methylated spirit	160	fl. oz.
Sandarac resin	12	oz.
Mastic resin	16	"
Powdered glass	16	"
Pale Venice turpentine	12	"
Turpentine varnish	10	fl. oz.

No. 9, White:

Methylated spirit	160	fl. oz.
Sandarac resin	18	oz.
Mastic resin	8	"
Turpentine	2	"

No. 10, White:

Methylated spirit	160	fl. oz.
Sandarac resin	32	oz.
Mastic resin	8	"
Elemi resin	4	"
Strasburg turpentine	16	"

All the above hard varnishes can be polished when dry and hard. They should be laid on with a brush used always in one direction, so as not to generate froth, for if they do, they dry dull and lusterless; twenty-four hours is usually sufficient time to allow them before proceeding to polish.

Soft White Varnish.

Methylated spirit	160	fl. oz.
Sandarac resin	24	oz.
Gum elemi	16	"
Anime resin	4	"
Camphor	2	"

White Shellac Varnish.

Methylated spirit	160	fl. oz.
Freshly bleached shellac	24	oz.

If the shellac is not freshly bleached, it will not readily dissolve, and if it be not perfectly dry, the varnish made therefrom will be dull and cloudy.

Shellac varnish may be bleached by the use of animal charcoal as follows:

Dissolve 24 ounces orange shellac in 160 fluid ounces methylated spirit, and then mix with it 32 ounces of animal charcoal and warm the mixture for ten minutes by the aid of a sand bath, then test a little by filtering. If not quite light enough, add more charcoal, and when sufficiently colorless, filter off the whole for use.

A White Spirit Varnish.

Methylated spirit	160	fl. oz.
Pale Manila copal	54	oz.
Dammara resin	18	"
Bleached shellac	18	"
Toluol	54	"

Colored varnishes of any color may be produced by coloring any of the above varnishes with any suitable aniline dye soluble in spirit. It is a good practice to keep a stock of a quart or pint of spirit deeply colored with the dye, and then add a sufficient quantity of the colored spirit to the made varnish to produce the color desired. The dye woods may also be used in the same way, viz., by digesting them for several days in the spirit, straining and keeping the strained fluid for use, as above. A pint or quart of each color should be kept in stock, and then by mixing these as required any tone of color can be obtained for staining wood or varnishes.

Spirit Varnishes with Oil.

Some spirit varnishes are mixed with oil, in which case it is usual to dissolve the solid ingredients separately and then mix the fluids therewith. To effect the melting of the resin by heat, the apparatus used in oil varnishes is required.

These varnishes are prepared by melting the solid resin in a copper vessel until fluid, then adding hot linseed oil (not boiled with litharge or any other lead salt), and, after mixing these materials, turning the compound into another vessel, which can be heated, and boiling the mixture until all cloudiness disappears, and the mass can be drawn out into strings when pinched between finger and thumb. When this point in the heating of the mixed oil and resin is reached, then the mass is ready for the thinning process, which is effected by the addition of turpentine. As this fluid is volatile and very inflammable, the oleo resinous mass should be allowed to cool somewhat before adding the turpentine, and the mixing should always be conducted in some place where there is no fire or naked light. There is always risk of a conflagration in the making of oil varnishes, and, therefore, the buildings in which the operations are carried out should be constructed with this contingency in view. More explicit details for preparing oil varnishes are not here given on that account.

Formulæ for Oil Spirit Varnish—Amber Varnish.

Ingredients :

Amber resin (chip amber of a pale color)	3	lb.
Pale copal	3	"
Sandarac resin	3	"

are put into the gum pot (i. e., the vessel in which the resins are melted) and heated until fluid; meanwhile 18 pounds of linseed oil is heated (but not boiled, or it will become decomposed), and this is run in on the melted resin. The mixture is stirred and then run out into another vessel where it is boiled until stringy, and when cooled enough to safely admit the addition of turpentine, sufficient of that fluid is added to bring the mass to the right consistency.

Cabinet Makers' Varnish.

Sandarac resin	8	lb.
Boiled oil	4	"

Boil until the mass is stringy, and then thin with 12 pounds of turpentine.

Kauri Copal Varnish.

Pale kauri copal	8	lb.
Boiled oil	4	"
Turpentine	12	"

Prepare as last recipe.

Pale Copal Varnish.

Sierra Leone copal	8	lb.
Boiled linseed oil	4	"
Turpentine	14	"

Prepare as above described.

Oil Varnishes.

These are prepared from oil that has been boiled with some drying agent, such as litharge, zinc sulphate, borate of manganese, and require very careful and skillful attention in their preparation.

The oil has to be carefully boiled under certain conditions with the drying agent, the "gums" have to be melted in a separate vessel, and the compounding of the ingredients for producing a perfect varnish needs the exercise of skill that is acquired only by experience. As already stated, only the practical varnish maker can undertake the production of such varnishes to be remunerative. The following formulæ, however, will put the reader in possession of the composition of such varnishes.

A dark oak varnish is prepared from the following ingredients :

Raw linseed oil	42	gal.
Flake litharge	15	lb.
Sulphate of zinc	15	"
Kauri gum	164	"
Turpentine	36	gal.

The oil is first boiled with the litharge and zinc sulphate until it is sufficiently boiled to a linseed oil varnish, the gum is melted in the gum pot, the boiled oil mixed with it, the mixture boiled until stringy, and finally the mass is thinned with the turpentine.

A pale oak varnish is prepared from the following ingredients :

Raw linseed oil	40	gal.
Litharge	15	lb.
Kauri gum	132	"
Hard copal	48	"
Turpentine	36	gal.

Prepared as in last recipe.

A cabinet varnish is prepared by melting

Gum anime	28	lb.

then boiling this with

Heated raw linseed oil	1½	gal.

until stringy, then mixing with

Turpentine	11½	gal.

A "carriage" varnish, which is the general name given to varnishes that are used in the building trades, is prepared as an oil varnish from the following ingredients :

Linseed oil	42	gal.
Litharge	15	lb.
Kauri gum	60	"
Anime	60	"
Copal resin	60	"
Turpentine	40	gal.

Mineral turpentine varnish is made by digesting altogether :

Mineral naphtha	1	gal.
Turpentine	1½	"
Pale resin	18	lb.
Venice turpentine	7	"
Boiled oil	2	"

Flatting varnish consists of melting 8 pounds anime resin, mixing 2 gallons of oil, and then of boiling the mixture for 4 hours, and then thinning with 3½ gallons of turpentine.

Wainscot Varnish

consists of :

Anime resin	8	lb.
Clarified oil	3	gal.
Litharge	4	oz.
Dried white copperas	4	"
Dried sugar of lead	4	"
Turpentine	5½	"

Prepare as in oak varnishes.

Body Varnish.

Anime resin, best	8	lb.
Boiled oil	2	gal.
Turpentine	3½	"

Prepare as in last recipe.

Elastic Hard Varnish.

a. Copal resin	8	lb.
Oil	2	gal.
Dried sugar of lead	4	oz.
Turpentine	3½	gal.
b. Anime resin	8	lb.
Oil	2	gal.
Dried copperas	4	oz.
Turpentine	3½	gal.

Prepare each varnish (a and b) separately, and then mix the two and incorporate by boiling together.

Hard Church Oak Varnish.

Kauri gum	8	lb.
Oil	3	gal.
Turpentine	5½	"

Dissolve the gum in the gum pot, heat the oil, and mix the two until the mixture strings well, and finally thin with the turpentine.

Pale Oak Varnish.

Gum copal	8	lb.
Oil	3	gal.

Melt the copal and mix with the oil, then add

Dried copperas	4	oz.
Dried sugar of lead	4	"
Litharge	4	"

Boil the mixture until it strings well and thin with 5½ gallons turpentine.

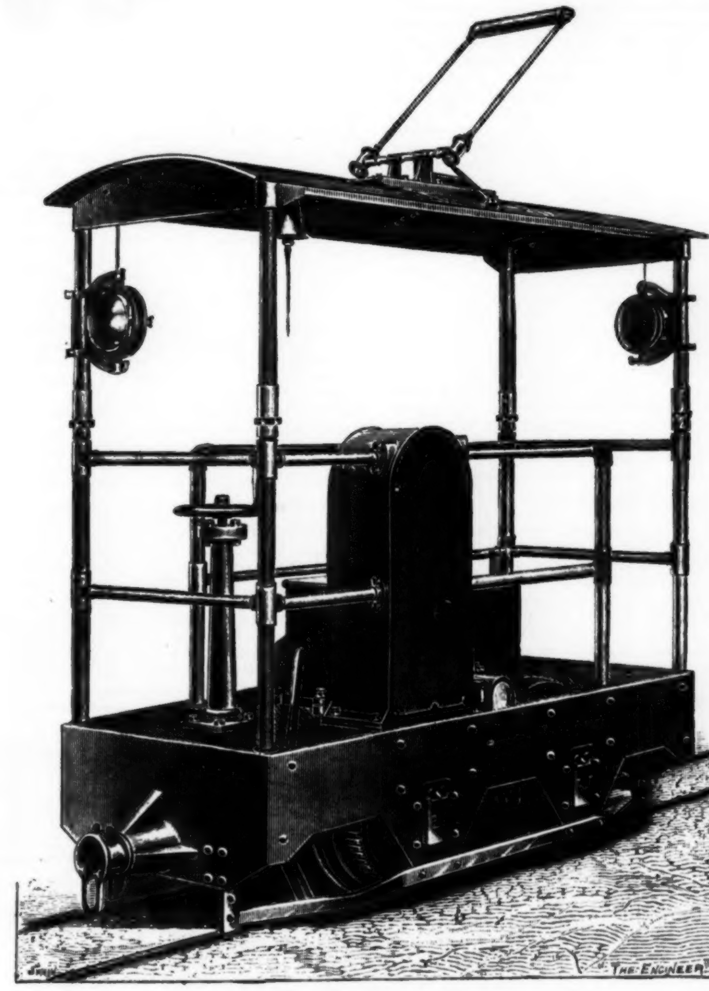
Pale Copal Varnish.

Palest copal resin	8	lb.
Pale boiled oil	2	gal.
Turpentine	5½	"

Melt the resin, mix with the heated oil, boil until it strings well and thin with the turpentine.—The Builder.

CONTRACTORS' ELECTRIC LOCOMOTIVES.

SIX contractors' electric locomotives for the Baker Street and Waterloo Railway are being made by Messrs. Thomas Parker, Limited, of Wolverhampton. Our illustration shows a general view of these locomotives, says The Engineer. They have been specially designed to meet the conditions of Messrs. Burstall and Monkhouse's specification, which among other things provides that the maximum width over all should not exceed 3 feet. The result has been that space has had to be economized to the utmost extent, and an extremely handy locomotive produced. No working parts are uncovered, though all portions of the machinery are easy of access, and there is a glass window over the commutator, by means of which the behavior of the brushes can be observed. The current will be obtained from an overhead wire, from which it will be collected by a long contact roller bar, instead of the more usual grooved wheel, thus permitting of a greater sideway deviation of the conductor wire without fear of breaking contact. The wire conveying the current to the switch passes down from the roof of the vehicle through one of the upright tubes placed at each corner of the footboard. Each locomotive is fitted with a series motor, the armature of which is wound with Messrs. Parker's patented Eickemeyer coils, and connected by double helical gearing to both the axles. The locomotive develops 15 to 20 brake horse-power when supplied with current at an electromotive force of 200 volts, and it is designed to run at ten miles an hour on a level track. The starting and reversing motions are controlled by one handle. This handle works a throw-over reversing switch, fixed at the top of an inclosed box, and is also geared to a resistance switch, the contacts of which are connected to resistance coils of platinoid inside the box. A light iron detachable canopy or roof is fitted so that it can be taken off in case it is required to pass the locomotive through a small opening. The motors are entirely inclosed in the frame of the locomotive, to protect them from dust and wet. Lamps, an efficient brake, and sand-boxes, together with buffers which form part of the draw-bars, render these locomotives complete in every detail.



CONTRACTORS' ELECTRIC LOCOMOTIVE.

JEWS IN PALESTINE.

THE United States consul at Beirut, in an interesting report which he has recently addressed to his government, says that in view of the impetus given to the Zionist movement by the Second Zionist Congress, held at Basle in September last, and also by the Palestine journey of the German Emperor, the present status of Jews in Palestine becomes a matter of general interest. Out of a total population in Palestine of some 200,000 souls, about 40,000 are Jews, as against 14,000 twenty years ago. In Jerusalem there are 22,000 Jews, half of whom have immigrated from Europe and America, and are called Aschkenazim, to distinguish them from the Oriental Israelites, the Sephardists. Nine hundred and sixty families, numbering about 5,000 souls, inhabit the twenty-two Jewish colonies in Palestine, which have been founded and subsidized by Europeans, ten by Baron Edmond de Rothschild, representing the Alliance Israelite Universelle, the rest by the Jewish Colonization Association and by the Odessa Company. The idea of gathering in Palestine homeless Jews scattered all over the globe was championed in the forties, but with indifferent success. In the eighties, however, the immigration of Jews into Palestine assumed significant proportions. Of the twenty-two present colonies the "Jacob Memorial" is the largest, supporting more than 1,000 souls. It boasts a school with five teachers, a synagogue, etc., and 4,000 acres of land under cultivation, on which are grown fruit (chiefly grapes) and mulberry trees, the rearing of silk worms being a leading industry. The "First to Zion" is another important colony owning 2,000 acres of land. Some forty two-storied stone dwelling houses greet the eye of the approaching stranger; also a school house with a Hebrew library, a synagogue, and a hospital. One million five hundred thousand vines and 25,000 almond, orange, and mulberry trees belong to this colony, which also possesses famous wine cellars. The "Hope of Israel," a mile below Yafa, in the plains of Sharon, is, perhaps, best known for its agricultural school, in which one hundred or more pupils are taught gardening. Recently a high school for Jewish girls was established in Yafa. The "Head Corner Stone" amid the hills beyond Tiberias, with snow-capped Hermon in the background, is another prosperous Jewish colony in Palestine. Being near the source of the Jordan, water is plentiful, and its situation high up above the level of Lake Gennesareth insures fair climatic conditions. In the "Door of Hope" dairy farming is profitably followed, and experiments made in tea planting. This colony is said to have 1,000,000 vines. The consul adds that, entirely irrespective of whether or not the Zionists will succeed in awakening in the Jewish people a national spirit, and forming a Judean monarchy or republic, with its parliament in Jerusalem and its representation in foreign capitals, the present agitation makes for the development of a country which is but a shadow of its former self, and which will generously respond to

modern influences. The Sultan seems quite disposed to grant railway, harbor, and other franchises, and it is possible that the new Jewish Colonial Bank, the organization of which was decided upon in Basle, will be permitted under certain guarantees to play an important part in the industrial advancement and growth of Palestine. The movement is furthermore bringing out new qualities in the Jews residing in Palestine. The consul is of opinion that the prospects are brighter now than ever for the Jews in Palestine and for Palestine itself. European influence has obtained a foothold in the country, and the tide of modern ideas cannot be long resisted.

THE PREPARATION AND SOME OF THE PROPERTIES OF PURE ARGON.*

By WILLIAM RAMSAY, F.R.S., and MORRIS W. TRAVERS.

IN the memoir on argon, and new constituent of the atmosphere, by Lord Rayleigh and one of us, reasons are adduced on pages 235 and 236 in favor of the supposition that argon is an element, or a mixture of elements; and on page 236 the following words occur: "There is evidence both for and against the hypothesis that argon is a mixture; for, owing to Mr. Crookes' observations of the dual character of its spectrum; against, because of Prof. Olszewski's statement that it has a definite melting point, a definite boiling point, and a definite critical temperature and pressure; and because on compressing the gas in presence of its liquid, pressure remains sensibly constant until all gas has condensed to liquid. The latter experiments are the well known criteria of a pure substance; the former is not known with certainty to be characteristic of a mixture." And on pages 257–259 of the same volume, it is shown by Prof. Sydney Young and one of us that the ratios between the boiling points of argon and benzene, argon and alcohol, and argon and oxygen on the absolute scale are such that it is possible to compute the boiling points of argon at different pressures with very considerable accuracy. We therefore draw the conclusion: "It is hardly likely, though not impossible, that so good an agreement would be obtained with a mixture or an impure substance. It is, at any rate, certain that a distinct want of agreement would have shown that argon was not a definite, pure substance, and the results may be taken as affording additional confirmation of the conclusion that argon is a definite, hitherto unknown constituent of the atmosphere, and that it has been isolated in a state very closely approaching to purity."

The density of a sample of argon prepared by means of magnesium was found by one of us to be 19·941 (O = 16); and a much larger preparation by Lord Rayleigh, obtained by exposing a mixture of air and oxygen to an electric flame in presence of caustic soda, possessed the density of 19·94. Supposing argon to be a simple substance, and not a mixture, the atomic weight would therefore be 39·88. An attempt was made by Dr. J. Norman Collie and one of us to effect a separation of argon into a light and a heavy portion passing by diffusion, but without definite results. While the density of the portion passing first through the pipe-clay septum was 19·93, that of the last portions was 20·01. We remarked on these figures in the following terms: "These numbers show that no important separation has been effected. The difference in density of the two portions may possibly be attributed to experimental error. . . . As it stands, the difference is an extremely minute one, and it may, we think, be taken that any separation of argon, if effected at all, is very imperfect."

It thus remained uncertain whether argon was a mixture or not, although the balance of evidence went against the supposition.

When helium was discovered in 1895, a new light was thrown on the question. Its density, determined by Ramsay and independently by Langley, closely approximates to 2·0. Experiments, in conjunction with Dr. Collie, and subsequently by ourselves, showed that no great difference in density could be brought about by fractional diffusion, and, indeed, the latter revealed no impurity, except traces of argon. On grounds similar to those from which a corresponding conclusion for argon was drawn, the atomic weight of helium must be somewhat below 4·0. The difference between the atomic weights of helium and argon is consequently about 36; and this is approximately the difference between the atomic weights of manganese and fluorine (36), chromium and oxygen (36·3), vanadium and nitrogen (37·4), and titanium and carbon (36·4). But between each of these pairs of elements there exists another, exceeding in atomic weight the lower member of each pair by approximately 16. It was, therefore, to be expected that another element should exist with atomic weight about 20, and on the assumption that, like helium and argon, it too would be a monatomic gas, its density would be 10. It was with the object of attempting to discover this unknown gas that the experiments on the fractional diffusion of helium were made, and the gases evolved on heating some fifty minerals were investigated in order to find out whether a new spectrum could be observed, but with negative results.

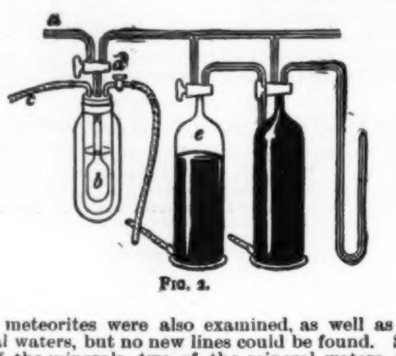


FIG. 2.

Seven meteorites were also examined, as well as six mineral waters, but no new lines could be found. Sixteen of the minerals, two of the mineral waters, and one of the meteorites were proved to contain helium, but if the gases extracted from them contained any gas other than helium or a trace of argon, it must have been in quantity too minute to have revealed itself to the spectroscope.

The gas which we were in search of was ultimately found in argon. The argon, amounting to about 15 liters, was prepared by means of apparatus of which a description is given in the sequel. From the air employed in a liquid state for the purpose of liquefying and fractionally distilling the argon, two other elementary gases have been obtained, besides one yielding the "Swan" spectrum. A preliminary account of all these gases has already been given in the Proceedings of the Royal Society under the names of "Neon," or "new," "Krypton," or "hidden," and "Metargon," and at the meeting of the British Association at Bristol, the discovery of "Xenon," or "the stranger," was announced. The removal of these gases from argon has put us in possession of pure argon, and the present paper deals with some of its properties.

THE PROPERTIES OF PURE ARGON.

In order to prepare 15 liters of argon, it is necessary to deal with about 1,500 liters of atmospheric air, of which approximately 1,200 liters consist of a mixture of nitrogen and argon. To absorb the nitrogen contained in this quantity of gas by conversion into nitride, 4 kilogrammes of magnesium would be required theoretically, but in order to cover loss through leakage and incomplete action, 5 kilogrammes of the metal are employed. The absorption of the oxygen and nitrogen was conducted in three stages. In the first, the oxygen was removed by means of metallic copper; in the second, the nitrogen was passed twice over metallic magnesium; and in the third, the gas, now rich in argon, was finally freed from nitrogen and hydrogen by passage over a mixture of anhydrous lime and magnesium powder heated to a red heat, and subsequently over red hot copper oxide. The apparatus employed is shown in detail in the annexed figure.

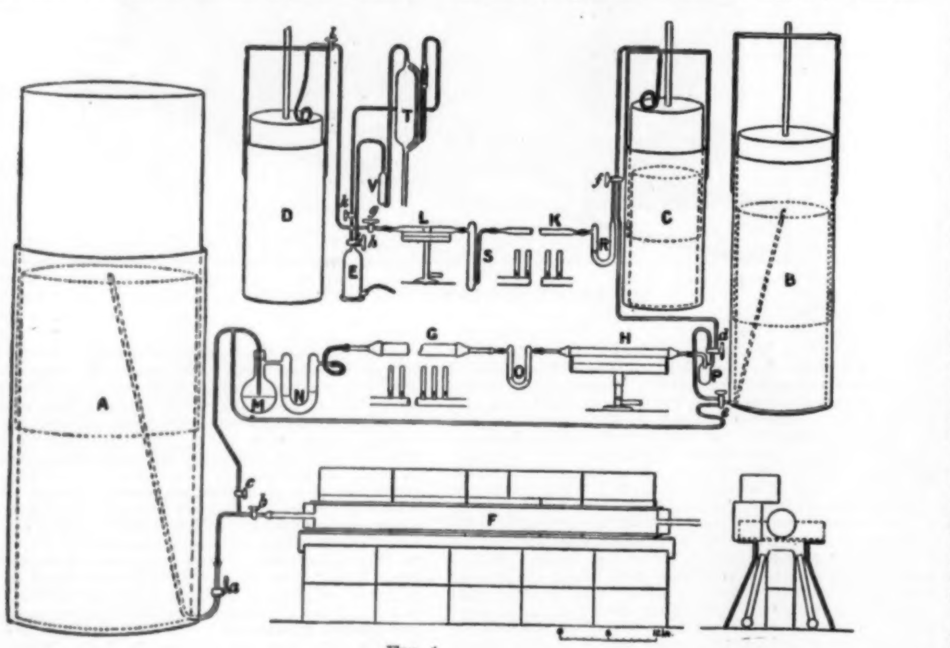


FIG. 1.

It was of course necessary to confine the gas over water between the successive stages of purification, and finally to store the gaseous argon in the same way. On account of the considerable solubility of argon in water, this would have entailed no small loss if the quantity of water with which it had been brought into contact had been large. We consequently decided to make use of gas holders of the gasometer type, in which the water was contained in an annular space of small capacity. Balance weights were attached to cords passing over pulleys, and served to relieve the pressure on the gas due to the weight of the gasometer. As the volume of the gas decreased after each successive stage, the four gas holders employed were of different sizes; the capacity of *A* was about 180 liters; that of *B*, 27 liters; and of *C* and D, each 18 liters.

Atmospheric nitrogen was obtained by drawing air, freed from carbon dioxide by passage through caustic soda solution, over heated metallic copper. A large iron tube, *F*, 3 feet 6 inches long and 3·5 inches in diameter, containing 25 pounds of scrap copper, was connected with the gas holder, *A*; the tube was heated in a long firebrick trough during these experiments, but a gas furnace is shown in the figure, which has now been substituted for the more primitive arrangement.

The time required to fill the gas holder was usually about five hours, and it was found, on analysis of the gas, that one single operation sufficed for the complete removal of all oxygen. The oxidized copper was reduced between each operation by means of coal gas.

By closing the stop-cock, *b*, and opening the stop-cock, *c*, the gas holder, *A*, could be placed in communication with the apparatus in which the preliminary absorption of nitrogen took place. By placing weights on the top of the gas holder, the nitrogen was driven through the vessel, *M*, and the U-tube, *N*, both of which contained strong sulphuric acid, into the tube, *G*, which contained magnesium. This tube was a piece of steam barrel, 1·5 inches in diameter, connected at each end by a reducing socket with an iron tube, 0·25 inch in diameter. The tube contained 250 grammes of magnesium, cut into coarse shavings in a shaping machine; the magnesium was not pressed very tightly into the tube. Since after each operation it was necessary to remove the sockets in order to clear the tube, the joints were luted with red lead, and the tube was made of sufficient length to project about 3 inches at each end of the furnace.

The greater part of the nitride was generally removed by using an iron rod, and the remainder by means of water, which converted it into the hydroxide. The tube was raised to a bright red heat before connecting it with the U-tube, *O*, in order to allow the greater part of the hydrogen occluded by the magnesium to escape. The absorption of the nitrogen, which was indicated by the rate of flow of the gas through the U-tubes, *N* and *O*, was maintained briskly until practically the whole of the magnesium was converted into nitride; the volume of the gas absorbed was equivalent to half the capacity of the large gas holder.

The gas, after leaving the U-tube, *O*, passed through a second iron tube, *H*, containing copper oxide; next, through the vessel, *P*, in which water condensed; and it finally collected in the gasometer, *B*. That which passed during the first stages of the process consisted of nitrogen containing much argon, but toward the end of the operation the argon became much diluted, until finally the gas which passed through the U-tube, *O*, consisted almost entirely of atmospheric nitrogen. The tube, *G*, was then replaced by another containing a fresh supply of magnesium.

The tap, *c*, was then closed, and the taps, *d* and *e*, turned, so that the gas in the gasometer, *B*, could be made to flow through the magnesium and copper oxide tubes into the gasometer, *C*. In this process its volume was very much reduced, and the gas which collected in *C* probably contained as much as 25 per cent. of argon. When the whole of the gas had been expelled from *B*, the taps, *d* and *e*, were again turned, and atmospheric nitrogen was allowed to flow through the magnesium tube, as in the first stage of this operation.

When the gasometer, *C*, had become full of the mixture of nitrogen and argon, as it did at the end of every third or fourth operation, it became necessary to reduce its volume by further absorption of nitrogen. The method employed, which was first described by Maquenne (Compt. Rend., 1895, vol. cxxi., p. 1147), consisted in passing the gas through a hard glass tube containing a mixture of magnesium powder and lime, heated to a dull red heat in a combustion furnace. The lime was obtained by thoroughly calcining precipitated chalk in a muffle. The nitrogen continued to be completely absorbed as long as calcium remained unattacked, so that the product of this operation consisted of pure argon. The gas issuing from the calcium tube passed through a tube, *S*, containing soda-lime, and over copper oxide in the tube, *L*, on its way to the gasometer, *D*. Since at the end of the operation the system of tubes between the gas holders, *C* and *D*, contained argon, in order to avoid loss the circuit was placed in communication with a Töpler pump, *T*, through the stop-cock, *k*. The space between the stop-cocks, *l* and *f*, was exhausted at the commencement of the operation, the exhaustion being continued till the greater part of the hydrogen, which is always evolved when a mixture of magnesium and lime is heated, had been given off.

When it was necessary to suspend operations, the taps, *l* and *f*, were closed, the tap, *k*, was opened, and the argon was taken into the pump and delivered into the vessel, *V*, which covered the upturned end of the capillary tube of the pump. From *V* the argon could be drawn into the small gas holder, *E*, which contained mercury, and which could also be placed in communication with the system through which the gas passed on its way from *C* to *D*.

These operations were repeated until the gas holder, *D*, contained about 15 liters of argon. The whole of this argon was then liquefied in an apparatus of which Fig. 2 is a representation. The argon entered through the tube, *a*, into the bulb, *b*, of some 25 c. c. capacity, surrounded by liquid air contained in a double-walled vacuum jacket. The air was made to boil under a low pressure of a few centimeters of mercury by means of a Fleuss pump attached to the tube, *c*. The argon rapidly and completely liquefied to a colorless mobile liquid; it showed no absorption spectrum. Its volume was about 17·4 c. c. By turning the tap, *d*, it was placed in communication with the first of the series of mercury gas holders, *e*; the reservoir was then lowered so as to remove the lower boiling portions of the liquid. During this distillation, which took place at constant temperature, the pressure on the boiling air was kept as low as possible. This gas subsequently turned out to be rich in neon, and to contain helium

* A paper read before the Royal Society, December 15, 1898, and published in Chemical News.

(Roy. Soc. Proc., lxiii., 437). The remainder of the argon boiled back into the gasometer until the last few drops were left; the residue solidified, and finally gave a gas to which we gave the name metargon; it was collected in mercury gas holders (loc. cit., p. 439). As will be subsequently shown, the krypton and xenon in this quantity of argon are too minute for detection. A similar operation for the purpose of separating the lighter as well as the heavier constituents was afterward repeated three times, the middle portion of argon being always returned to the gas holder, *D* (Fig. 1). A fourth liquefaction was carried out in which six mercury gas holders were filled with six separate fractions of argon, each taken after each successive fifth of the total argon had evaporated. These fractions were next purified from any nitrogen accidentally present by sparking with oxygen over caustic potash. After the removal of the oxygen, the density was determined.

(To be continued.)

A CINEMATOGRAPH CAMERA WITHOUT VIBRATIONS.

THE apparatus described below has recently been invented by M. G. Maroniez, with a view of suppressing completely, or to as great an extent as possible, the vibrations which generally exist in similar apparatus.

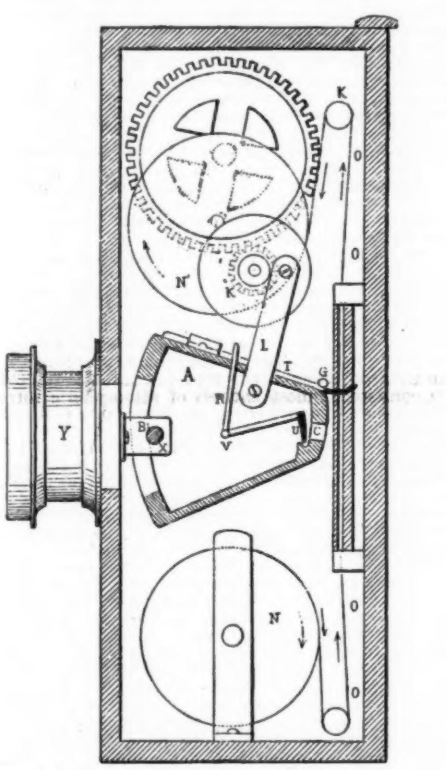
The present cinematographs consist of three parts:

First. A quick, intermittent forward movement of the film, producing change of image and stoppage of the same for an instant.

Second. A shutter which opens and closes at equal intervals.

Third. A mechanism which makes these movements synchronously.

It is very necessary to obtain absolute concord between them, so that the admission of the light will coincide exactly with the stopping of the film, which



TRANSVERSE SECTION OF CAMERA, SHOWING ARRANGEMENT OF PARTS.

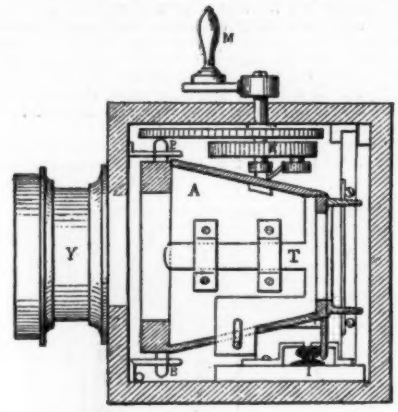
must be absolutely immovable during the projection, as in ordinary lantern slide work. (The same apparatus serves at the same time for taking negatives or projecting positives.) The connecting mechanism consists either of gearing or of eccentrics, St. André crosses, etc., but however perfect its construction may be, it is almost impossible to construct it with absolute precision. Suppose we take, for instance, fifteen projections per second; then each second must contain fifteen movements and fifteen stoppages of the film, or thirty different phases. If these phases be equal—a thirtieth of a second each, for instance—it will be necessary that the opening of the shutter, which must occupy at the most a thirtieth of a second or rather less, coincide exactly with the thirtieth of a second during which the film is at rest, and this coincidence must be so precise that the shutter does not begin to open the very smallest fraction of a thirtieth of a second too soon, or does not remain open the least bit too long; otherwise, the film will have had time to continue its movement, and this, however small it may be, when enlarged on the screen becomes visible, and, repeated with each picture, produces a series of vibrations very disagreeable to the eye, which are present in all the existing apparatus.

It will readily be seen that this defect can be remedied by suppressing the cause, namely, the connection between the film-moving part of the machine and the shutter, and having only a single part to control these two movements

The principal part in accomplishing this is a movable box which acts at the same time as a film-mover and shutter. The shutter is constructed on the principle of plate shutters. It does not cover the objective, which is allowed to remain open, but obscures the sensitive surface of the film by means of a narrow strip of the same width as the film.

The truncated box, *A*, is fastened on the pivots, *B B*, behind the objective, and has a vertical swinging motion on them. It is open at the lens end, and in the other end, which has the least curvature of the two, is a narrow slit, three millimeters wide. At each oscillation of the box this slit passes close to the film, covering the entire height of the picture. The machine is so arranged (as will be explained below) that the slit is closed when the box rises, and allows the light to pass when it falls.

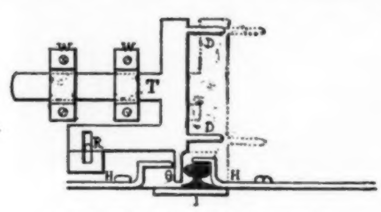
To the top of the box is fastened a T-shaped piece, *T*,



SECTION SHOWING TOP OF SHUTTER BOX.

from the arms of which two small teeth, *D*, project five or six millimeters, while a guide arm, *G*, projects from the side.

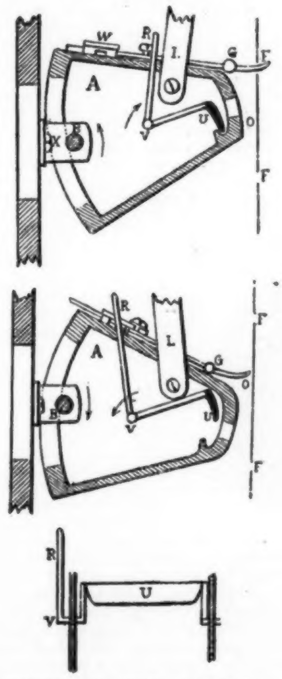
This piece, *T*, moves back and forth in a groove, a distance of from five to six millimeters, so that according to whether it is pushed out or drawn in its teeth engage or disengage the film by means of the single holes in both edges of the film (Lumière's perforation). The piece, *T*, is guided in its reciprocal movement by the arm, *G*, which is continually pressed



DETAILS OF FILM MOVER.

against the cam, *I*, by small spring pushers, *H*. The cam, *I*, is fastened to the inside of the box in such a way as to make the teeth enter or withdraw from the holes according as the box is at the bottom or top of its course. It does this by advancing the piece, *T*, when the box is lowered, and withdrawing it the moment the box is raised.

The slot, *C*, is opened or closed by the strip, *U*, placed in the box, *A*, and pivoted horizontally at *V*, whence an upright, *R*, enters a slot in the piece, *T*, thus making



SHUTTER BOX RAISED AND DESCENDING. DETAILS OF SHUTTER.

CAM AND PUSH SPRINGS.

the two movements—the moving of the teeth forward and backward, and the closing and opening of the slot—sure and simultaneous.

The up-and-down motion of the box, *A*, is obtained by means of an eccentric, *K*, which is operated by a gear wheel turned by the crank, *M*.

It may be seen from the preceding description that each time the box rises, the teeth, being advanced, draw the film upward a distance of one picture, while the shutter remains closed at the time, and consequently no light passes. When the box descends, however, as the teeth are withdrawn the film remains immovable, while the shutter opens and allows the light to pass.

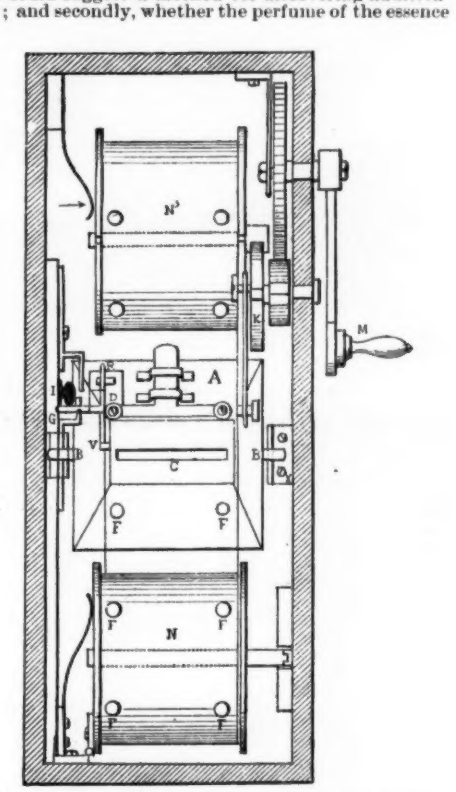
The apparatus is completed by the two film rollers, *N N*, which may be inserted or taken out with ease. The receiving roller is actuated by a friction pulley attached to the main driving wheel; this pulley is not needed in the apparatus for projection.

In making the exposure, the film passes through a slide, *J*, the back of which opens on a hinge to permit of introducing the end of the film before each operation. The door at the back is a sliding one. It is kept shut during the taking of the views, thus completely closing the apparatus, and is opened for projection.

It will be readily seen that by means of the above arrangement, since the film is moved directly by the shutter apparatus, it is necessarily immovable during the time of exposure or projection, and that thus the principal cause of the vibrations is suppressed.—Bulletin de la Société Photographique du Nord de la France.

CALABRIAN BERGAMOT.

IT will be interesting to English perfumers to note that great efforts are being made to secure the purity of the essence of bergamot, which is largely exported from Calabria, and forms the basis of many principal perfumes. According to Consul Neville-Rolfe, the crucial test is the proportion of a substance called Acetato di liniale, which is the ingredient which gives the odor to the essence. The essence has been frequently adulterated with lemon juice, thereby, of course, diminishing the proportion of the essential ingredient in the fluid put upon the market. The Chamber of Commerce of Reggio delegated the examination of samples to the Agricultural School of Palermo, and asked for information on the two points—first, whether they could suggest a method for discovering adulteration; and secondly, whether the perfume of the essence



LONGITUDINAL SECTION, SHOWING END OF SHUTTER BOX.

of bergamot arose exclusively from the liniale contained in it. The replies obtained were unsatisfactory, as the tests proposed, such as the polarization of light, are not sufficiently practical for the use of ordinary people, and are only suitable for a scientific man in a specially fitted laboratory. In August, 1897, a law was passed by the Italian parliament against the adulteration of essences, but as it includes shumac and other substances, it will be inoperative as to bergamot, on account of the present insufficiency of chemical methods to detect adulteration, and thus to set the law in motion. The export of bergamot from the province in 1896 was 180,835 kilogrammes (398,000 pounds avoirdupois) at about 6s. 1d. per pound. Now, this is a low price, the price in 1891 having been 11s. 7d.; and, taking the average price of the last ten years, it appears to have reached 8s. Essence of lemon brings 4s. 9d., and essence of orange about the same. It will be seen from this that until the adulteration of bergamot with lemon juice can be detected, there is a great temptation to increase the quantity of the more expensive essence by the addition of the cheaper one. It is strange, says the consul, that the attention of the perfumery trade should never have been directed to South Italy. The flowers of the orange and lemon trees, so carefully collected in the south of France, are allowed in South Italy to rot upon the ground, and might be had in any quantity for the asking. Roses and many other scented flowers grow there in wonderful profusion. Bergamot, which is the active ingredient of many scents, is to be had in plenty, and it looks as if there were a good opening for perfumery works. The soapmakers alone would be large customers.—Journal of the Society of Arts.

Calico print works use 40,000,000 dozen eggs per year, wine clarifiers use 10,000,000 dozen, the photographers and other industries use many millions, and these demands increase more rapidly than table demands.

THE PRODUCTION OF ARTIFICIAL PEARLS FROM THE HALIOTIS.

As a sequel to the experiments made by me, says M. Boutan in La Nature, in the Roscoff laboratory of M. de Lacaze-Duthiers, the latter recently presented to the Academie des Sciences a paper in which I described the artificial production of pearls in the haliotis. This paper attracted the attention of the public much more by the nature of the subject than by the scientific result obtained, which was quite mediocre.

The starting point of the experiment was as follows: I asked myself if it would not be possible to produce pearls artificially in marine shells, and particularly in those of the Gasteropods. Many of these animals, in fact, exhibit a very iridescent nacre which appears capable, in depositing itself in circular layers, of furnishing the pearls sought.

For the experiments that I made with the Gasteropods I chose the haliotis. This mollusk is abundant on the rocky bottom of the English Channel, where it attains a large size. Internally, its shell is covered with a layer of very brilliant mother-of-pearl; and, moreover, it is very well adapted for experiment. Placed in the large tanks of the Roscoff laboratory, where the researches were made, it readily acclimates itself, and, provided that it is furnished with well aerated water in sufficient quantity, no attention need be paid to its alimentation. All the specimens experimented with secreted nacre at the level of the foreign substances introduced, and in several shells pearls of nacre, genuine, fine pearls, were moulded. In Fig. 2 may be seen one of these pearls still in place in the interior of the shell, the animal of which was extracted after an experiment of five months' duration.

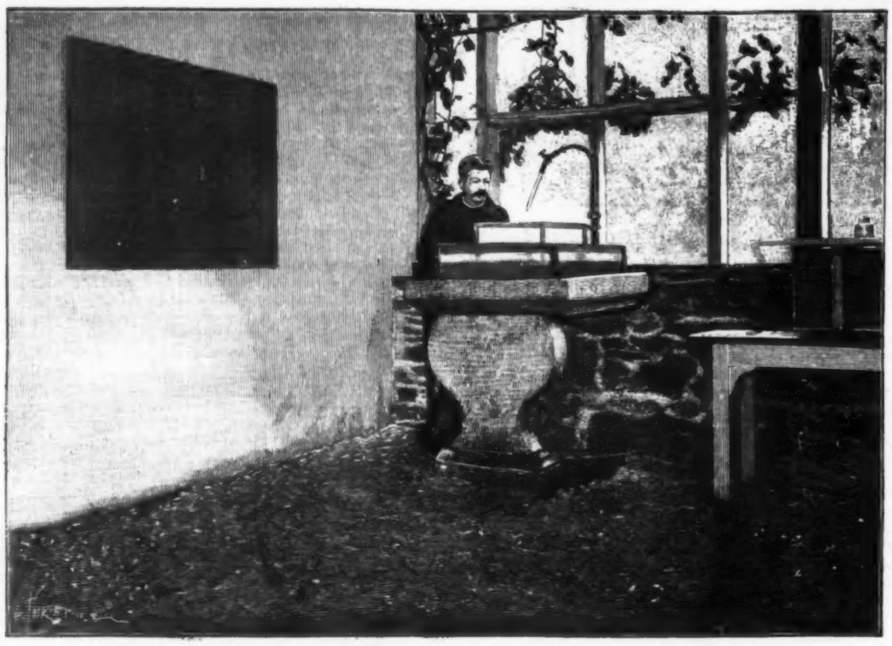


FIG. 1.—TANKS OF THE ROSCOFF LABORATORY.

The first pearls obtained were not sufficiently detached from the shell, and exhibited too wide a base of junction with the latter. In the subsequent experiments this defect was partially corrected; and, in recent specimens, it may be seen that the part of the pearl nearest the shell is covered with a layer of nacre.

It must be remarked, however, that although the pearls thus obtained artificially have the same chemical composition as natural ones, and have circular layers only at the periphery, which gives them the aspect sought, they contain in the interior a large nucleus of nacre of which the placing of the layers is necessarily different from that of the periphery. It must be remarked, too, that the heliotides are not reared in a globe, like gold fishes, and that in order to succeed in making them live under normal conditions, one must have previously acquired extensive knowledge relative to the biology of marine animals.—La Nature.

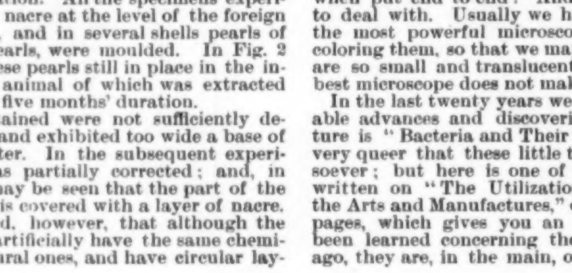


FIG. 2.—SHELL CONTAINING A PEARL.

BACTERIA AND THEIR USES.*

TO-NIGHT I have for my subject one which I am always glad to talk about, since it relates to our friends; for the bacteria are our friends, rather than our enemies. A great many of us have gained in some way a horror, or sort of distrust, of the bacteria, believing them to be purely and simply our enemies. The study of them is a new one; that is, it has only been practically about twenty years since we began to make a science of the bacteria and the knowledge to be gained concerning them. I do not mean to say that the bacteria have only been known twenty years; in fact, they were discovered over two hundred years ago, as early as 1683, or possibly a little earlier, by Anthony von Leeuenhoek, who was a linen draper's apprentice, and who, experimenting with microscopes, was able to see and tell us—chiefly by drawings—what he saw in different organic fluids, such as beef broth, milk, and stagnant water. These drawings have come down to us; and we now know that he saw, described, and drew the bacteria, which, however, he believed to be little animals.

There is nothing very difficult in the science of bacteriology if we firmly fix in our minds that it is simply a branch of botany; in other words, that the bacteria are plants. As such, practically every one of the problems of the science can be solved. These plants are much smaller than we can imagine. I am not sure that I have ever yet been able to comprehend exactly the size of any of the bacteria. There are some the 1/25,000 of an inch long; others twice or three times as big, and others somewhat smaller. Can you comprehend anything of which it takes 25,000 to make an inch when put end to end? And yet that is what we have to deal with. Usually we have to resort not only to the most powerful microscopes, but to staining or coloring them, so that we may see them; because they are so small and translucent, unless stained, that the best microscope does not make them clearly visible.

In the last twenty years we have made some remarkable advances and discoveries. The title of my lecture is "Bacteria and Their Uses." You may think it very queer that these little things have any use whatsoever; but here is one of two volumes of a book written on "The Utilization of Micro-Organisms in the Arts and Manufactures," of more than five hundred pages, which gives you an idea of what has already been learned concerning them. As I said a moment ago, they are, in the main, our friends. We speak of disease germs; and yet, when we come to think of it, we have not so very many diseases that are contagious or infectious. About four years ago Surgeon-General Sternberg, of the United States Army, published what is, as yet, the best work on bacteria and bacteriology in the English language; and he catalogued practically all the species known at that time. There were then very close to five hundred; and probably this number covers the list of all the known species. I think I shall be right in saying that there are probably not more than fifty or sixty forms of these which are disease germs in the true sense of the word and which affect either plants or animals. Not more than ten per cent., therefore, of the known species of bacteria are what we call pathogenic, or disease producers. The rest are probably of some real use; and it is very likely, also, that the disease germs have a use or purpose in this world of which, as yet, we know nothing.

With these small organisms practically everywhere prevalent, there must be some function for them. When I say they are vegetables, that calls to mind, of course, certain characteristics that we have in our minds that distinguish them from the animal kingdom. We know that all living things are made up of cells; we get a simplification of the idea when I tell you that all the bacteria are single-celled organisms; that is, each individual is made up of a single cell. We are made up of many millions of cells. Every plant or animal of a higher type is made up of many cells: but each one of the bacteria is practically a single-celled plant. There are two other kinds of vegetables that are made of single cells; and with both of these most of us are quite familiar: The yeasts that we use in our baking and brewing and the moulds that we do not like to get in our jellies and our preserves, but which we are apt to see almost everywhere that darkness and dampness abound. These three classes make up the very tiniest bodies and organisms of the vegetable kingdom. When we get above them, we begin to talk of the higher plants. There are many points of resemblance between yeasts and moulds on the one hand and bacteria on the other. A difference is that the yeasts and the moulds grow by budding, just as the higher plants do; while the bacteria grow by splitting; that is, dividing in two. Remember that each one of the bacteria is a plant by itself—an individual that has the power of reproduction of life, growth, and development. When the time comes for one to reproduce itself, a little line shows down through the middle and it eventually splits into two parts. Then in a very few moments each part will have grown to be almost, if not quite, as big as the original; and you have two new plants, instead of one. Of course these two can reproduce themselves; and we thus have the plants growing by geometrical progression. To give you an idea of how fast these bacteria grow and might grow under the most favorable conditions, a number of experiments show that some of the species reproduce themselves as rapidly as once every thirty minutes; and it has been calculated that, taking one of say 1/12,000 inch in length and half that breadth, in forty-eight hours, if the conditions were entirely favorable for growth and reproduction, and supposing that none died, they would increase so that the progeny of the original one would fill a pint cup and would amount in numbers to 281,000,000,000. Let them go another seventy-two hours, and it is said that they would fill every ocean on the face of the earth and could only be counted by taking out figures to thirty-seven places. Fortunately, things are rarely favorable for such development; and I don't think any of us need get alarmed lest we be crowded off the earth.

I have described the bacteria as plants, without reference to whether they are disease germs or not. You find them everywhere: in the water, in the air, in the soil. They are plants; therefore, they must have nourishment—something on which they can grow. We find, however, that they can thrive on rather small rations: in other words, that the soil which will nourish them, and on which they will thrive, finds lodgment on the back of our hand, in our clothing—everywhere. They need some moisture; some comfortable temperature and some little amount of nourishment; and therefore we can find plenty of media on or in which they will grow—one of the best being milk; another, boiled potatoes; or, if we want a liquid medium, nothing is better than beef broth.

In such media they grow luxuriantly: they get into such a soil and will be there in spite of you; and the trouble is, not to get them there, but to keep them out of it. You can scarcely make a jelly or beef broth without the appearance in it, eventually, of a plenty of bacteria.

We find they are so plentiful everywhere that the different species of bacteria get mixed. How can we separate them? We cannot take a needle and pick them up individually, even under the microscope, one kind from another. They are too small; and, besides, different species may look exactly alike, even with the best lenses. We have to find a better way; and I think I can make clear to you such a way, discovered accidentally by Prof. Koch. To illustrate, you know the difference between a potato and a cabbage when you see them in the garden. Most of you probably know the difference between a crop of potatoes and a crop of cabbages growing in the fields, as you drive along a country road. Why cannot we look at the crop in bacteria, instead of looking at the individual? That is exactly what we do when we make them grow on culture media in mass. The contents of one of these test tubes here is more or less red, containing a species called Micrococcus prodigiosus; and another, here, more or less blue, containing the Bacillus pyocianeus. These are simply two different crops. The first is a crop of one kind of plant and the second is a crop of another kind. The farmer who farms bacteria gets as thoroughly acquainted with them as the farmer who farms larger crops; and you would just as soon expect the bacteriologist to get mixed as to these two kinds of bacteria as to have an agriculturist get confused as to potatoes and cabbages or pumpkins and corn growing in the same field.

I have here a number of different kinds of bacteria in test tubes, each kind growing by itself. There is one producing a beautiful green color, which color is thoroughly penetrating the jelly. Another here, while it is of a red color, has not tinted the jelly in the same way. Again, here is a black yeast, which shows its peculiar manner of growth. How do we get these different kinds separate from one another? Or, suppose you have a sample of water and want to know what kinds of bacteria are in it? How can you determine them, or what species are in the air of this room? It occurred to Prof. Koch that if we had some way of fixing the individuals in place until they could get well started in their growth, it would then be easy to isolate and to study them. Take the sample of water, for instance. Suppose we have a little gelatine in a test tube like this which has been thoroughly sterilized, so that there are in it no living germs of any kind; and suppose we melt it by heating it gently. If, now, we introduce into this a small portion of a drop of the water which we want to study and then thoroughly shake the gelatine, we will distribute through it whatsoever bacteria were in that little sample of water. Pouring the gelatine quickly onto a clean glass plate or dish, it cools almost immediately and each organism is held apart from every other one. If, now, the plate or dish be covered so that it may not be contaminated by other germs from the air or other sources, and set aside

* A popular lecture delivered January 15, 1899, at the Temple College, Philadelphia, by Seneca Egbert, A.M., M.D., Professor of Hygiene in the Medico-Chirurgical College, and of Anatomy, Physiology, and Hygiene in the Temple College, Philadelphia. Revised for the SCIENTIFIC AMERICAN SUPPLEMENT by the author.

in a place not too cold, these individual bacteria, locked in the gelatine, will begin to grow and reproduce themselves; and in a few hours little spots will appear all through the gelatine, and these will gradually increase in size. Each spot represents the offspring or is a colony of the species of bacteria which was represented in each case by a single individual held in place by the cooling. Now specimens may be taken from each of these spots, or colonies as we call them, and be either studied under the microscope or else transplanted to new culture media for further growth and experiment. In this way we separate the various species, of which there may be a number, in the sample of water we had to examine. To collect the germs from the air we would simply expose a plate or dish of sterilized gelatine to the air of a given room for a short time, a moment or two, and then, covering the same, we would have the reproduction taking place as above and could make our separation as indicated.

In this way we have been able to study the different kinds of bacteria, and, by further experimentation, we are able to determine their various properties. As to the means of studying the bacteria further, I may only refer again to the use of the microscope aided by the proper staining methods, and add that, as far as disease germs are concerned, experimentation upon living animals becomes necessary. Some day there will be a fourth method of study, which will be that of the chemical products of the bacteria. Just as we now in pharmacy study the products of higher plants or separate out their active principles, so, some day, we will be studying the products of the various bacteria; and I will venture to say that this study will become a profitable one when viewed from many standpoints.

In what way do the bacteria benefit us? They seem so small, and are the smallest living things on the face of the earth. Yet they can benefit us in a great many ways. There is, first of all, this great thought, that all our nutriment, all the reconversion of dead matter into food for plants, is dependent upon them. We used to be taught that the oxygen of the air caused things to be decomposed, and that is true to a certain extent, because many of the bacteria need oxygen to bring about decomposition; but the oxygen by itself cannot and will not cause decomposition as we ordinarily know it; that is, putrefaction and the like. You can take a tube like this containing milk or beef broth, and so long as you sterilize it primarily and close it with a cotton plug, in this way, to keep out the bacteria, it will keep for years. The oxygen of the air has free access to it, but as long as the bacteria cannot get to the liquid within it will not spoil, will not decompose, and we have no marked change taking place in it. In other words, we know now that, practically, decomposition is dependent on bacteria, and, upon the whole, that after things die they must be decomposed before they are fit for plant food again. What are plants made of? Largely of starches and sugar, which are simpler by far in composition than our bodies and our tissues. These starches are made of nothing but water and carbonic acid gas that we find in the air and the soil, compounds that contain two or three elements only in them; and yet our starches and other foods from plants are changed into still more complex tissues and structures by our bodies when we eat them. In other words, all life is the building up of complex from simpler compounds, and this goes on continuously in every organism until death.

Then what happens? If there is to be no physical decomposition, those things remain the same, and as long as they do remain the same such bodies are of no use to future generations. If we did not decompose after death we would, in fact, only encumber the earth, and the earth by this time would be pretty well filled with dead people and dead things. But, fortunately, Nature, by the action of the bacteria, decomposes all dead things and gives their substance back to Mother Earth, to be used again as plant food. Thus, were it not for this decomposition of things that have lived and died, the plants of to-day would themselves soon die, for we can easily understand how the plant life in the world on which all animal life is dependent would eventually and rather quickly use up all the food material now in the soil of the earth. Thus it is through the agency of our friends, the bacteria, that decomposition is largely produced, that our own food is provided; and if it were not for them we would soon be short of provender. For instance, one of our most noted sanitarians holds that we are actually dishonest if we allow ourselves to be cremated rather than be buried after death, in that we cheat Mother Earth out of just as much as we have taken from her in the form of our bodily elements.

There has been another very important discovery made within the last few years, which is simply this: that a great deal of the food supply of certain classes of plants is dependent upon other peculiar classes of bacteria, not in that they give food in the way I have indicated, but in a peculiar way. We used to be taught that the nitrogen of the atmosphere was there simply to dilute the oxygen and to keep us animals from living out our lives too rapidly; in other words, it was not supposed or known that the plants got any of their nitrogen supply directly from the air. Most plants, if you try to grow them in a soil without nitrogen, will dwindle and die; but if we take those of the Leguminosae (such as pease, beans, and clover), we find they have the power not only of growing in a soil deprived of nitrogen, but even of storing up in their substance large quantities of this element in various forms, and for that reason crops of such plants are grown on land for the purpose of adding to it the nitrogen which it lacks. As I say, it has lately been discovered that it is to certain species of bacteria that this family of plants owes this faculty. They are present in the earth and form little nodules upon the rootlets of the plant, enabling the latter to absorb very considerable quantities of nitrogen from the atmosphere and to store it up in the way I have indicated, so that these plants, in turn, furnish us with a large part of our nitrogen food.

Again, we are just on the threshold of great commercial advances—of advances in the knowledge of industrial processes; and we shall employ in every way now unconsidered these smallest living things—the bacteria—to bring money into our pockets. For instance, certain processes in tanning are dependent upon the fermentations caused by the action of certain kinds of bacteria. They not only decompose and hasten the removal of the epidermis and hair from the hides, but, by producing gases of fermentation, puff up the tissues of the true skin or hide, thus allowing the tanning agents to enter and to tan every portion of it, and they are, therefore, an important factor in this industry.

Most of you know that indigo comes from a plant; but the plant does not give the blue color as other plants give dyes. The plant has to be crushed and put in large quantities in vats, with water, and allowed to remain for a time until fermentation, which, again, is due to certain bacteria, takes place. This fermentation brings about certain changes in the substance produced by the indigo plant, and eventually, as a result of the chemical action, the blue indigo falls to the bottom and is then purified and prepared for market.

In the preparation of flax, the flax plant is beaten and crushed so as to break up the bark, which has to be retted or rotted off by the action of certain new kinds of bacteria, which, by the way, are of only two or three species. As certain localities are noted for their flax, in Ireland, in Belgium, in Russia, and on this continent, so they are noted for their water, which has this property of retting flax; in other words, the bacteria seem to be more prevalent in the waters of certain places than of others, and the flax industry can be carried on better at those places.

Bacteria precipitate the iron ore that is found in large quantities in certain bogs. As some of you know, there are immense deposits of bog iron in New Jersey. This has been deposited in immense quantities from the water which has taken it up, perhaps a long distance away, from the iron ore that is in the earth. This deposition of iron ore is due, again, to the agency of bacteria, which cannot grow without decomposing the oxide of iron borne in the water and which throw it down in the deoxidized condition, making great deposits. It is interesting to know that in certain cities abroad, which use a water heavily charged with iron, the bacteria have thrown down at times so much of this metal that the pipes and reservoirs have been seriously clogged thereby. In Lille, a few years ago, they found that over half of the deposit in their reservoirs was practically bog iron.

We know that in all animal tissues there is some sulphur; but these same sulphur compounds, when the animal has died, have to be not only decomposed but have to be worked over by special bacteria before they can be of use again and be taken up by plants for their nourishment and for the future nourishment of higher animals. In the same way the cellulose, which is the woody fiber that forms the skeleton or supporting structure of plant life, undergoes a peculiar decomposition and conversion; and here again new species of bacteria come into service.

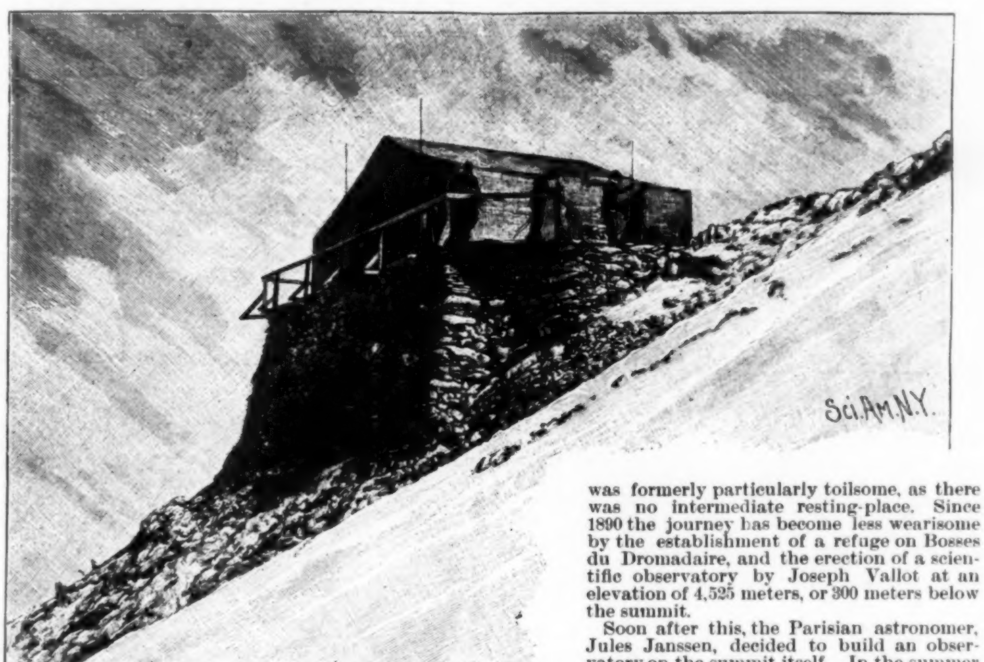
I might go on and enumerate many other ways in which the bacteria are practically and commercially useful; but perhaps it will suffice if I inform you that even in the preparation of our foods we are making practical use of them. The making of cheese and the souring and curdling of milk (which is precedent to all butter-making) are each due to certain kinds of bacteria. They need some of these to convert the milk sugar into lactic acid, which, in its turn, causes the curd to form. We need others to ripen the curd and to give it its peculiar flavors that make one kind of cheese different from another; and lastly, in the making of butter scientifically, we now utilize our knowledge of bacteriology.

A few years ago Prof. Conn, of Wesleyan University, isolated from a particular butter a peculiar kind of bacteria which has the property of giving to the butter made from milk to which it has been added a flavor exactly similar to what we call a "June," or "grass," flavor. Some of you know that there are certain dairies from which you cannot get good butter, no matter how careful or how cleanly the people are who make the butter. A bad taste persists and nothing that can be done seems to remove it. This is practically due to the fact that the dairy is infested with certain bacteria which, by their action upon the cream and other parts of the milk, produce disagreeable flavors. On the other hand, the kind discovered by Prof. Conn is one that not only overcomes these evil bacteria, but which produces such delicate and agreeable flavors as to always insure a first class product. This species, which is commercially known as the "Conn bacillus No. 41," is now sold to a large number of dairies and creameries throughout the country; and it is used in this way. A culture of the bacteria is added to half a pint or so of milk or cream which is kept at a certain temperature. The bacteria rapidly grow, and at the end of a few hours the milk or cream containing them is added to the churning and allowed to stand a little while, just as you allow your bread sponge to stand after adding the baker's yeast. The milk, or rather, the fatty acids in the cream of the milk, are broken up by the chemical action which these bacteria engender, and, as a product or result, we have the delicate flavor or flavors which I have mentioned and which are retained by the butter. To continue the action of the bacteria, it is only necessary to save a little of each day's churning to add to the milk reserved for the next, just as the housewife saves a little of her yeast for the next baking.

(To be continued.)

THE MONT BLANC METEOROLOGICAL OBSERVATORY.

The ascent to the summit of Mont Blanc is usually begun at Chamonix, and the journey generally requires three days. On the first day the Alpinist passes Pavillon de la Pierre Pointue, and arrives at the little inn of Grands Mulets (3,050 meters); on the second day he climbs Petit Plateau, and reaches Grand Plateau (3,932 meters). Here he turns either to the right and climbs up to Dôme du Goûter (4,331 meters) and Bosses du Dromadaire (4,450 meters), or to the left, and travels past Mur de la Côte and Petits Mulets (4,666 meters) to the summit (4,810 meters). On the same day he returns to Grands Mulets, where, for a second time, he passes the night. On the third day he arrives at Chamonix. The journey through the ice and snow, from Grands Mulets to the summit and back again,



VALLOT'S OBSERVATORY ON MONT BLANC.

was formerly particularly toilsome, as there was no intermediate resting-place. Since 1890 the journey has become less wearisome by the establishment of a refuge on Bosses du Dromadaire, and the erection of a scientific observatory by Joseph Vallot at an elevation of 4,525 meters, or 300 meters below the summit.

Soon after this, the Parisian astronomer, Jules Janssen, decided to build an observatory on the summit itself. In the summer of 1891 he erected a temporary frame house, and in 1893 the king of the Alps was crowned with a permanent astronomical observatory.

These two achievements of science were of no little value to many Alp-climbers; for the two French savants were most lavish in the dispensation of their hospitality.

Although Janssen has planted his telescope on the very summit of the mountain, Vallot's observatory has lost none of its value. It had and still retains its advantages. It is more homelike and comfortable than Janssen's observatory, and for that reason has attracted many scientific investigators.

After its completion, Vallot came every summer to his observatory, and pursued those interesting studies which have made him so well known in the scientific world. But he soon made a discovery which caused him to abandon the observatory which he had built, and to erect a new one. He had noticed that his pluviometer showed a marked annual increase in the depth of the snowfall the last four years, the increase in that period being 1·50 meters. He observed that his observatory, which at first was formerly snow-free, was now often snowed in. Apart from the expense incurred in removing the snow from a building erected at so great a height, he found that the rooms were becoming damper and consequently less inhabitable.

For a time Vallot struggled against these difficulties, but finally he decided to build a new dwelling on a rock in the vicinity. Last summer the old observatory was torn down and the erection of a new one begun. As soon as the season became more favorable, Vallot had the framework of the new building carried up from Chamonix to the mountain. Soon after he followed with workmen. The rock having been blasted away and leveled, the building was begun on July 29, and by August 19 was completely roofed in. In forty-four days the observatory was ready for occupation.

While his new observatory was being erected, Vallot lived on the mountain. Only three of his men remained with him during that time; the others were repeatedly compelled to descend in order to recover from the evil effects of the rarefied atmosphere.

The new observatory is 10 meters (32·80 feet) long and 6 meters (19·68 feet) wide. Its smallest height is 2·20 meters (7·21 feet) and greatest height 4 meters (13·12

feet). The roof is covered with sheet copper. The interior is divided into a kitchen, a dining-room, and laboratories.

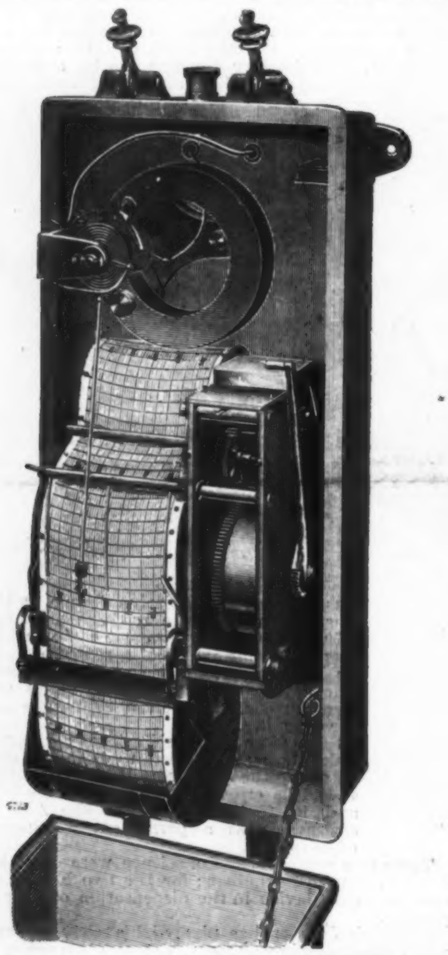
The observatory is in every respect most favorably situated. From its eleven windows the eye can range from the Savoy Alps to the snow-capped peaks of the Dauphiné. From the other side the lovely valley of Chamonix greets the view.

Telegraphic communication has been established between Vallot's observatory and the meteorological station at Chamonix.

The observatory last year dispensed its hospitality to 161 Mont Blanc tourists and 300 guides and sheltered two scientific expeditions. Last summer Vallot climbed to the summit of Mont Blanc for the twenty-fifth time. —Illustrirte Zeitung.

ELLIOTT'S RECORDING VOLTMETER.

WE illustrate on this page a recording voltmeter made by Messrs. Elliott Brothers, of St. Martin's Lane, London, W. C. This firm make two patterns of these instruments, says Engineering, one being intended for station use, while the other, which is fitted with a leveling device, is portable. The former is the one which we have chosen for illustration. It has an outer case of cast iron, and the casting, we may add, is an excellent specimen of the founder's art. The essentials of the instrument are the clock which moves the paper under the recording pen and the ammeter or voltmeter operating the latter. In the instrument illustrated this voltmeter consists in the first place of a permanent magnet, between the poles of which is a sphere of soft iron, which is supported on a bar secured to the framework of the instrument. The object of this iron sphere



ELLIOTT'S RECORDING VOLTMETER.

is to increase the magnetic flux. A ring of insulated copper wire surrounds this sphere, passing between it and the magnet poles. This ring is mounted on pivots, and is constrained to occupy one definite position, when no current is flowing, by the springs shown. A long arm of aluminum extends from the arbor supporting the above ring to the paper on which the record is to be made, and is provided at its lower extremity with an aluminum pen which can be charged with any suitable aniline ink. The clock, which, in our illustration, is represented with one of its cover plates removed, drives by friction a drum on to which the graduated paper is pressed by a spring presser. Holes perforated in one margin of this paper pass over studs on the rim of the drum, and entirely prevent any slip. The standard clock used in these instruments is arranged to feed forward the paper at the uniform rate of 1 inch per hour, but special movements are also provided giving a feed of 3 inches per hour, 6 inches per hour, and 6 inches per minute, and these can be fitted at purchaser's option. The paper after having passed under the record is delivered into a sheet metal receiver shown at the lower part of our engraving, where it coils itself up and from which it can easily be removed for examination. The clock will run for eight days, and is wound by the lever shown at the side. There is thus no loose key to be forgotten or mislaid. Fresh coils of paper can easily be fixed in position. These coils are sold already wound on a wooden roller, having a hole at each end. These holes take center pins mounted on spring bars secured to the frame of the recorder, and to remove an old roller it is only necessary to press back one of these spring bars. This done, the new roller can easily be put in position. The recording part of the instrument can, of course be used for other measurements besides those connected with electricity.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers, 361 Broadway, New York.

TABLE OF CONTENTS.

1899.

nent.

r.

s in any
dollars a

from the
. Price,

can like-
yearly.
or $3.50

AMERI-
SUPPLE-

nts, and

v York.

65

he classifi-
d illustra-
nd in any
panies it.
anada and

York.

ment

and Coast
, machine
and opera-
also fully
re all fully
the small
organiza-
ls. Never
y. The il-
ze Supple-
closed in a

s.

New York.

ON

N.

fail to

yearly

ns of a

EACH.

rk.

S!

e publica-
examine
ts for In-

, and now
s, Specifi-
e United
attend to
Reissues,
siness in-
y reason-

informa-
ing Trade
gements,

showing
ntries of